DUST HAZE EXPANSION ON MARS: ENSEMBLE SIMULATIONS. Ogohara[1], K., [1]Japan Aerospace and Exploration Agency, Institute of Space and Astronautical Science (3-1-1, Yoshinodai, Chuo, Sagamihara, Kanagawa, ogohara@gfd-dennou.org).

Introduction: Dust is the major source of the solar heating in the Martian Atmosphere and then the transport processes of dust for a long time period should be investigated precisely for climate change researches. [1] and [2] revealed that the surface albedo on Mars had decreased for about 30 Mars years after the Viking mission. However, it is unknown whether the distribution of the surface albedo, which is a result of the dust transport in the atmosphere, is in transition or in equilibrium. Therefore, climatology of the atmospheric processes governing the dust transport in the atmosphere has to be investigated at first. [3] found five favorable regions for dust haze expansion (FRs) and revealed what kind of the atmospheric phenomena controls the dust haze expansion around such regions. However, it still remains unclear whether these five FRs are also favorable for dust haze expansion climatologically because they performed just a single year calculation. Thus, I specify the climatologically robust FRs in this study by ensemble simulations.

Experimental description: Each ensemble simulation is performed in the same manner as that by [3]. Although [3] could not separate injected dust from the background dust due to the model architecture, I modify the model in this study so that I can treat the injected and background dust separately. The background dust distribution is set to that used by [4]. As shown in Fig. 1, the first spin-up run started from an isothermal (220 K) condition with constant surface pressure (6.4 hPa) and no wind over the entire planet. Twenty kinds of small disturbances are added to the temperature output data of the first spin-up run. The small disturbances of temperature at each σ level are normal random numbers. The standard deviation of the distribution function is 0.01 times of the standard deviation of temperature at the σ level of the first spin-up result. The second spin-up runs are performed for 1 MY from Ls=180 independently using the 20 kinds of the output data of the first spin-up run with small disturbances as the initial data. After these spin-up runs, twenty global maps of dust haze expansion potential are made using the output data from the 20 kinds of the second spin-up runs as the initial data I also perform a control map produced using the output data from the second spin-up run without the small disturbances. The numbers of hours in a sol and sols in a MY are set to 25 hours and 660 sols.

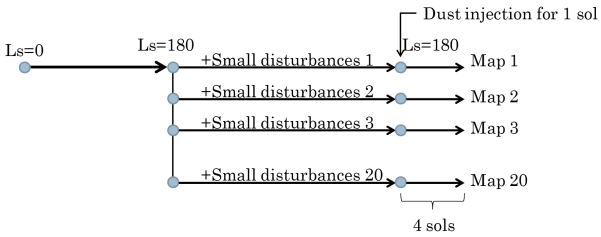

Fig. 1. A schematic view of ensemble simulations in this study.

Preliminary results:

A control map. Fig. 2 shows a global map of dust haze expansion potential for the control case on 3 sols after the start of dust injection. Each box indicates a location of each dust source. Each color indicates area of a dust haze injected from each dust source, which is defined as an area with the dust optical thickness (visible) of > 0.26. Favorable regions for dust haze expansion are 1) the Arabia, 2) the east of Tharsis, 3) the Sirenum—Aonia region, 4) the east of Elysium Mons and 5) the northern Utopia. Dust hazes do not tend to expand easily in high latitudes, the Margaritifer Terra and the Hellas Basin.

Ensemble mean and standard deviation. Fig. 3 shows ensemble means and standard deviations of dust expansion potential among the 20 ensemble members. Regions with high averages and low standard deviations of dust expansion potential are robust favorable regions for dust haze expansion, which are the Arabia Terra, the east of Elysium Mons and the vast regions from the Sirenum to the Aonia including the Solis Planitia and the Daedalia. Dust hazes around these regions were transported widely into other areas in most of the 20 ensemble members. Therefore, actual

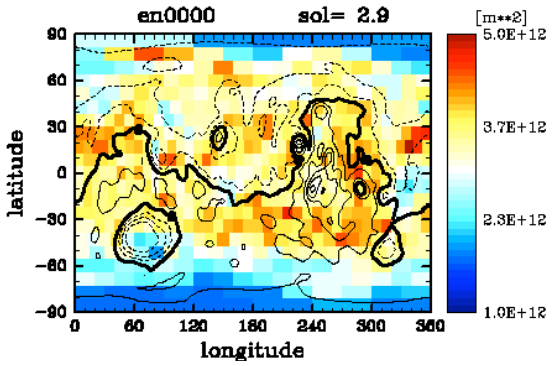

Fig. 2. A global map of the dust haze expansion potential on 3 sols after the start of dust haze injection for the control case. The black contours indicate the surface height. The contour interval is 2000 m.

regional dust storms initiations around these regions depend on whether a local dust haze with the horizontal scale of <1000 km is initiated or not by the mesoscale and microscale wind systems.

The two storm track in the northern hemisphere, the Utopia and the Acidalia, are not remarkable FRs although these were regarded as the outstanding FRs by [3]. However, dust hazes around these regions were transported widely in some ensemble members as suggested by the result that the standard deviations of expansion potential are relatively large. Fig. ?? shows all results corresponding to all ensemble members. Longitudes in which FRs in the northern mid-latitudes are located depend on the ensemble members. These transient FRs are probably associated with baroclinic waves in mid- and high latitudes.

Dust hazes that initiated from high latitudes does not tend to expand extensively because the ensemble means of the expansion potential are very low in spite of the high standard deviations.

Summary: I have detected the climatologically robust FRs by ensemble simulations with 20 members. The robust favorable regions for dust haze expansion are 1) the Arabia Terra, 2) the east of the Elysium Mons and 3) the vast regions from the Sirenum to the Aonia including the Solis Planitia and the Daedalia. Although the northern mid-latitude, especially the Utopia and the Acidalia, is not a outstanding FR, these regions become FRs in some ensemble members. Therefore, dust haze expansibility in these regions is probably associated with baroclinic waves. In the future, the number of ensemble members will be increased up to 100 because the number of the ensemble members in this study, 20, is probably too small. After that a sufficient number of ensemble simulations are completed, it is necessary to specify the atmospheric phenomena controlling the robust expansibility of dust haze around the robust FRs and to investigate the phenomena meteorologically.

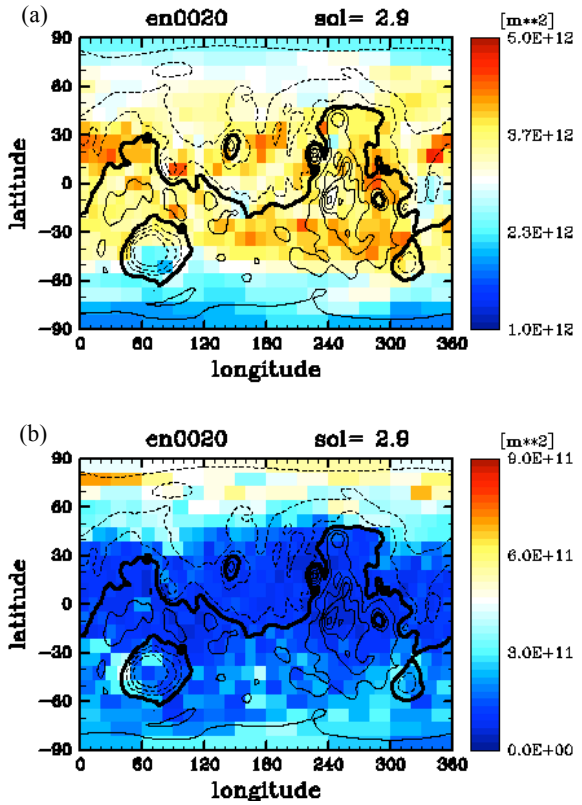

Fig. 3. (a) Ensemble means and (b) standard deviations in dust haze expansibility among all ensemble members.

References:

[1] Fenton L. K. et al. (2007) *Nature, 446,* doi:10.1038/nature05718, 646--649. [2] Szwast M. A. et al. (2006) *JGR, 111,* E11008, doi:10.1029/2005JE002485. [3] Ogohara K. and Satomura T. (1996) *ASR, 48,* 1279–1294. [4] Forget F. F. et al. (1999) *JGR, 104*, E10, 24155--24175.

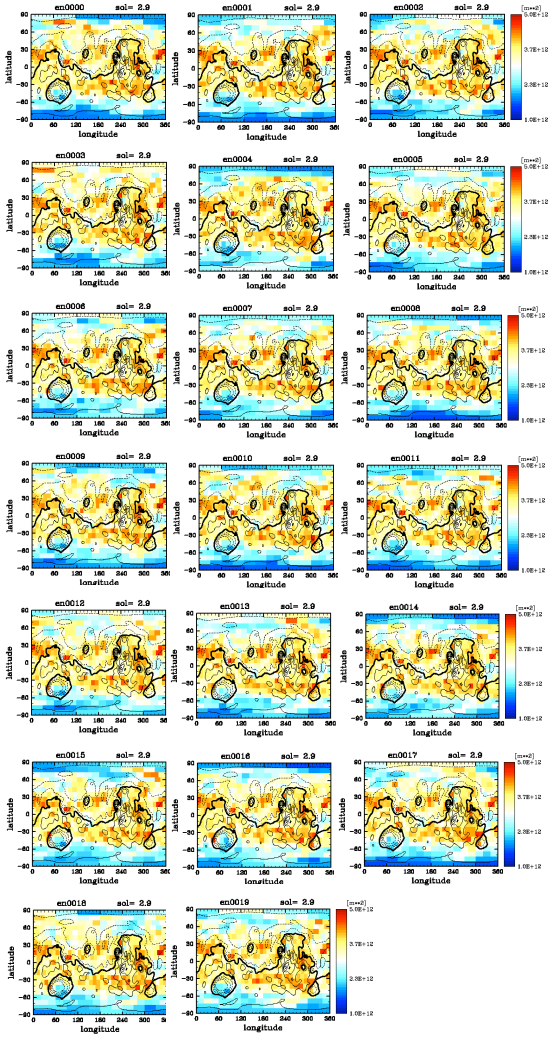

Fig. 4. Global maps of the dust haze expansion potential on 3 sols after the start of dust haze injection for the all ensemble members.